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OPTICAL RESEARCH AND DESIGN.

Simplified Method of Tracing Rays through any Optical System of Lenses, Prisms, and Mirrors. By Dr. Ludwik Silberstein. With diagrams. Pp. ix + 37. (London: Longmans, Green, and Co., 1918.) Price 5*s*. net.

THERE are two criteria for estimating the value of Dr. Silberstein's latest work. On one hand it possesses great theoretical interest, yet on the other it lays claim to practical usefulness. One must attempt to do justice to both aspects.

From the theoretical point of view the author's suggestion for the tracing of rays through optical systems is deserving of the highest commendation. Progress in the application of mathematics to problems in physical science is largely bound up with the art of economy of symbolical and mental effort, by means of the employment of the briefest possible notation and the most powerful analytical processes. The introduction of the vector notation into geometrical optics is therefore an important step in advance, and Dr. Silberstein is eminently the man to bring this about. He has already done much to initiate English students into the methods of vector analysis, and to convince them of its merits as a tool for the discovery of new results, and as a medium for the brief formulation of discoveries both old and new. In particular he has published some beautiful results of the application of vector analysis to optical research. The latter portion of the present book is a sufficient vindication of the claims of vector methods, and there can be no doubt that they represent the most powerful yet devised for attacking problems on reflection and refraction at systems of plane surfaces.

The optical computer is, of course, interested in plane surfaces; his main task, however, consists in the tracing of rays through systems of spherical surfaces, generally coaxial. In the first half of the book the author develops on vectorial principles the theory of ray tracing through such systems, and here, too, the superior merit of the vector notation is made evident. One must nevertheless remark that his strictures on the old *transfer formulae* are not fully justified, for it is possible to represent the transfer by means of a comparatively short and simple set of equations, even without the aid of vectors.

When, however, we come to the consideration of the practical aspect of the question, some doubts arise as to the merits of the formulæ thus derived. It is a great pity that exact schedules for computation by logarithms or by the calculating machine are not included; they would have greatly enhanced the value of the book. Even one or two actual examples, worked out in full, would have been welcome. It may be that the arithmetical processes contemplated by the author do not justify the suspicion, but one cannot help wondering whether the number of table-entries required by his formulæ does not exceed that required by the well-known Seidel formulæ. Further, it has been pointed out to the present writer that Dr. Silberstein's method possesses the disadvantage of using the cosines of many of the angles. For small angles—and in optical systems most of the angles of incidence, refraction, and convergence are only a few degrees—cosines define the angles with very little accuracy. Thus in the case of angles of about 10° the sines are six times as accurate as the cosines, whilst logarithmic sines are about thirty times as accurate as logarithmic cosines. The further discussion of the vector method in the light of these two criticisms would be very desirable, and students of geometrical optics will welcome any further contributions from Dr. Silberstein's pen.

S. BRODETSKY.

PETROL AND PETROLEUM.

(1) *Petroleum Refining.* By Andrew Campbell. With a Foreword by Sir Boverton Redwood, Bart. Pp. xvi + 297. (London: Charles Griffin and Co., Ltd., 1918.) Price 25*s*. net.

(2) *Petrol and Petroleum Spirits. A Description of their Sources, Preparation, Examination, and Uses.* By Capt. W. E. Guttentag. With a Preface by Sir John Cadman. Pp. xi + 135. (London: Edward Arnold, 1918.) Price 10*s*. 6*d*. net.

THE petroleum industry has developed enormously during the last few years, and processes of production and manufacture of products have so changed from the old "rule-of-thumb" methods which were in vogue in the early days that it is only natural for the literature on the subject to have increased in proportion. In the mass of literature in the English language which has been published on petroleum there has hitherto been no publication on petroleum refining, or one solely confined to petrol and petroleum spirits, both of which are of particular interest at the present time, when we are emerging from the throes of a world-war in which petroleum and its products have played such a prominent part.

Mr. Andrew Campbell, the author of "Petroleum Refining," is one of the pioneers of the British petroleum industry, and his views on the practical side of the subject are the outcome of experienced knowledge. It is rare that technical knowledge, experience, and clarity of diction are found together, but when so found they render the work of their possessor of inestimable value, and it is the possession of these qualities which is strikingly emphasised throughout Mr. Campbell's book.

The volume is divided into nine chapters as follows:—(1) Examination of the crude oil; (2) general departments; (3) storage of crude oil and liquid products; (4) distillation; (5) paraffin extraction and refining; (6) candle manufacture; (7) chemical treatments; (8) distribution of products; (9) engineering specifications; an appendix consisting of a bibliography of the literature (either published in English or of which extracts have been published in English) appertaining to petroleum refining, together with a name and subject

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index. The volume is also very well illustrated with 138 illustrations, which include twenty-nine folding plates and three diagrams, and it has eleven comparative tables.

Although in a short review full justice cannot be done to a work which is so full of information as this, yet a glance through the contents table shows its comprehensive character. When the design and erection of a refinery for the treatment of petroleum are projected it is very necessary that the fullest possible information with regard to the crude material should be obtained before anything further is done, and it is significant that the first chapter should deal with this branch. It contains a complete scheme with this end in view, which cannot fail to be of great use to all who are interested in the subject.

Without wishing unduly to criticise a chapter which is so full of necessary information, one would like to suggest that the portion dealing with "flashing points" and "colour" is somewhat too fully dealt with, as this branch appears in most text-books on petroleum, and belongs more to the testing of refined products than to the examination of the crude oil. Of special interest, however, is Fig. 30, giving the designs and arrangements for a five-gallon experimental still, and diagrams 1 and 3 of refining operations and yields of products.

The question of fire risks looms largely in the petroleum industry, and this subject is ably dealt with in chap. ii., which treats also of the departments necessary in refineries, apart from those necessary to actual refining operations. Chaps. iv., v., vi., and vii. discuss exhaustively the actual distillation, refining, and paraffin extractions, as carried out on the large scale, as well as candle manufacture, which in some refineries attains to large dimensions. The subject-matter of these chapters is exceedingly well handled, due stress being laid on the vital points which make for success in these operations, showing the mind of the man who is *au fait* with the general policy, as well as the detailed operations of the manufacture.

Chap. iv., on the subject of distillation, is well worthy of close study, embodying as it does all the up-to-date information available; and in this chapter also attention should be paid to the portion dealing with the question of heat exchange or conservation, as it behoves every oil-refiner to obtain the greatest possible yield from his oil, and by saving fuel a definite conservation results. In the chapter on chemical treatments one would have liked to see more attention paid to the manufacture of lubricants, which is only lightly treated, but is one of the more difficult of the refiners' problems. In this chapter is given a very complete description of the Edeleanu process, which to a large extent lessens the wasteful sulphuric acid treatment of oils. The engineering specifications given in chap. viii. will supply a long-felt want to the student, who so rarely has access to these essential details.

The book will undoubtedly become the standard work on the subject, and should be in the library of each and every person interested in petroleum.

(2) Petrol and petroleum spirits now play such an important part in the economic life of the nation that it is a matter for wonder that so little is known by the general public of their manufacture, constitution, and properties. In the work under notice Capt. W. E. Guttentag, who has had a unique experience in the last few years, has endeavoured to enlighten us, and has compiled quite a large proportion of the available knowledge on the question.

Capt. Guttentag would have been well advised to leave out of the book altogether chap. ii. on petroleum, (*a*) characteristics, (*b*) origin, (*c*) geological, (*d*) exploitation, (*e*) refining of crude oil, or to handle it much more fully than he has done, for the sketchy account which he has given is of little use to the serious student, and is only liable to give unbalanced ideas to the general reader. In any case, it would have been well through the whole of the book to give detailed references to original workers, for without these a technical work loses much of its value. An illustration of this, showing also how mis-statements creep into text-books and are copied and repeated until they are accepted as axioms, is the passage: "The bad smell of cracked spirits . . . is attributed to small quantities of sulphur and nitrogen compounds." This statement was first made by Rittman and then copied by Bacon and Hamor, whereas now it is a generally accepted fact that the smell of cracked spirits is due to that of the unsaturated bodies of the di-ene class which it contains.

The chief value of this work is in chap. v., which deals with the question of examination and testing both for routine and special work, in which the author has freely given of his special knowledge.

The book forms a useful little laboratory guide for those engaged in the testing of petrol.

WOOL INDUSTRIES.

Wool. By Frank Ormerod. ("Staple Trades and Industries." Vol. i.) Pp. xii+218. (London: Constable and Co., Ltd., 1918.) Price 6*s.* 6*d.* net.

THIS work covers in a general way the wool-growing and wool-manufacturing industries. More space is devoted to the sheep and to the wool trade than to the following manufacturing processes, but in no case can the treatment be considered exhaustive.

There are a few sins of omission and of commission which should be corrected in future editions of the work. For example, in dealing with the development of the wool comb on p. 31 no reference is made to the work of Isaac Holden; neither is there reference to the fact that Lister, in purchasing Heilman's English patent, was able to suppress the Heilman comb in Great Britain. It was not until 1900 that this comb, as made by

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